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A REVIEW OF THE HERRING-LIKE FISHES OF JAPAN

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BY

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and

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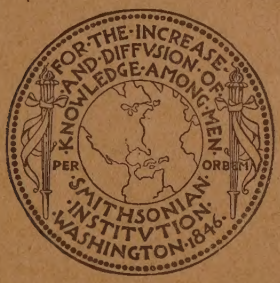
Of Stanford University, California

No. 1499.—From the Proceedings of the United States National Museum, Vol. XXXI, pages 613–645



Washington
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A REVIEW OF THE HERRING-LIKE FISHES OF JAPAN.

By David Starr Jordan and Albert Christian Herre,

Of Stanford University, California.

In this paper is given a descriptive list of the species of fishes related to the Clupeidæ, or herring family, known to inhabit the waters of Japan. The paper is based on the collection made in 1900, by Professors Jordan and Snyder. Series of the species named are in the United States National Museum and in the collections of Stanford University.

The Japanese herring-like fishes, *Isospondyli*, without adipose fin, belong to ten different families, most of them largely represented by extinct forms. Of all the bony fishes, these are the most ancient, and the most primitive, the families and some of the genus going back to Mesozoic times. They are connected by an unbroken series with the later ganoid forms. It is evident that, with the possible exception of *Pterothrissus*, none of these groups originated in the Japanese fauna. Each genus represented is widely distributed and as a rule but a single species of each one occurs in Japan.

ANALYTICAL KEY TO FAMILIES.

a. (Clupeoidea). Adipose fin, none.
  b. Head scaleless; no barbels.
    c. Dorsal fin inserted anteriorly, usually well before anal; shore fishes or river fishes, usually silvery in coloration and with the skeleton firm; air bladder well developed.
      d. Gular plate present, between branches of lower jaw; mouth large, teeth present, all pointed; lateral line present; axillary scales and sheaths large. Elopidæ, I
    dd. Gular plate, none.
      e. Lateral line well developed.
        f. Dorsal fin very long, of 55 to 65 rays, extending almost the length of the back; mouth small, inferior; skull cavernous.... Pterothrissidæ, II
        ff. Dorsal fin short, not extending the length of the back.
          g. Teeth present; no accessory branchial organ; mouth small, horizontal; posterior part of tongue and roof of mouth covered with coarse paved teeth..... Albulidæ, III
          gg. Teeth none; an accessory branchial organ behind gill cavity. Chanidæ, IV

ee. Lateral line wanting; no gular plate.

i. Mouth small, inferior, toothless, the maxillary simple or nearly so; stomach gizzard-like ..... DOROSOMATIDÆ, V

ii. Mouth moderate, terminal, the maxillary of about three pieces; stomach not gizzard-like ..... CLUPEIDÆ, VI

iii. Mouth subinferior, very large, below the tapering, pig-like snout; maxillary very long ..... ENGRAULIDÆ, VII

cc. Dorsal fin inserted far back, opposite anal.

j. Anal fin very long; belly sharp-edged; air bladder cellular. CHIROCENTRIDÆ, VIII

jj. Anal fin moderate, belly rounded; deep-sea fishes, of loose organization; mostly blackish in color; mouth small, with small pointed teeth; air bladder wanting .... ALEPOCEPHALIDÆ, IX

bb. Head and body covered with spinous scales; mouth with barbels; dorsal opposite ventrals; anal short; no air bladder ..... GONORHYNCHIDÆ, X

Family I. ELOPIDÆ.

Body elongate, more or less compressed, covered with silvery, cycloid scales; head naked. Mouth broad, terminal, the lower jaw prominent. Premaxillaries not protractile, short, the maxillaries forming the lateral margins of the upper jaw; maxillary composed of about three pieces, extending backward beyond the eye; an elongate bony plate between the branches of the lower jaw; bands of villiform teeth in both jaws on the vomer, palatines, pterygoids, tongue, and base of skull; no large teeth. Eye large, with an adipose eyelid. Opercular bones thin, with expanded membranaceous borders; a scaly occipital collar. Gill membranes entirely separate, free from the isthmus. Branchiostegals numerous (29 to 35). Gill-rakers long and slender. Pseudobranchiæ present or absent. Belly not keeled nor serrated, rather broad and covered with ordinary scales. Lateral line present. Dorsal fin inserted over or behind ventrals; caudal fin forked; no adipose fin; dorsal and anal depressible into a sheath of scales; pectorals and ventrals each with a long accessory scale. Parietal bones meeting along top of head. Pyloric cœca numerous. Species few, widely distributed in the tropical seas. Numerous fossil forms are referred to this ancient group, one of the oldest among bony fishes. The species are not much valued as food, the flesh being dry and bony.

KEY TO GENERA.

MEGALOPINÆ:

a. Pseudobranchiæ none; body oblong, covered with large scales; anal fin longer than dorsal; last ray of dorsal produced in a long filament.

b. Dorsal fin inserted over or slightly behind ventrals ..... *Megalops*, 1

ELOPINÆ:

aa. Pseudobranchiæ large; body elongate, covered with small scales; anal fin smaller than dorsal; last ray of dorsal not produced in a filament ..... *Elops*, 2

I. MEGALOPS Lacépède.

Megalops LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 289 (*cyprinoides*).

Body compressed, covered with large scales; no pseudobranchiæ; anal fin larger than dorsal fin; last ray of dorsal produced in a long filament; insertion of dorsal over base of ventral fins. Shore fishes of the Indian region, similar to the American Tarpon, or Grande Écaille (*Tarpon atlanticus*), but reaching a much smaller size. There is perhaps but one species.

(μεγαλώψ, large-eyed.)

I. MEGALOPS CYPRINOIDES (Broussonet).

Clupea cyprinoides BROUSSONET, Dec. Ichthyol., I, 1782, pl. IX (Island of Tanna, South Pacific; synonomy confused with *Tarpon atlanticus*).

Megalops filamentosus LACÉPÈDE, Hist. Poiss., V, 1803, pp. 289, 290, pl. XIII, fig. 3 (Fort Dauphin, Madagascar).

Clupea thrissoides BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 424 (based primarily on *cyprinoides* of Broussonet).

Cyprinodon cundinga HAMILTON-BUCHANAN, Fish. Ganges, pp. 254, 383 (Ganges River).

Megalops setipinnis RICHARDSON, Ann. Nat. Hist., XI, p. 493.

Megalops curtifilis RICHARDSON, Ichth. China, 1846, p. 310 (Canton).

Megalops indicus CUVIER and VALENCIENNES, Poiss., XIX, p. 388, pl. CXLII, 1846 (India).

Megalops macrophthalmus BLEEKER, Verh. Bat. Gen., XXIV, Chiroc., 1851, p. 15 (East Indies).

Megalops macropterus BLEEKER, Ned. Tydskr. Dierk., III, 1866, p. 284 (East Indies).

Megalops kundinga BLEEKER, Ned. Tydskr. Dierk., III, 1866, p. 288 (East Indies).

Megalops oligolepis BLEEKER, Ned. Tydskr. Dierk., III, 1866, p. 292 (East Indies).

Elops apalike DAY, Fish. Malabar, p. 228 (Malabar).

Habitat.—East Indies and South Seas, north to China and Riu Kiu Islands.

Head $4\frac{5}{6}$ in length; depth $4\frac{1}{3}$; D. 19; A. 25; P. 15; V. 10; scales in lateral line, 37; eye $3\frac{1}{2}$ head; snout $4\frac{3}{4}$; mandible $1\frac{5}{7}$; interorbital space equals snout; ventral $1\frac{5}{7}$ in head; caudal peduncle compressed, $2\frac{2}{3}$ in head.

Body oblong, compressed, deep; head rather small, conical; interorbital space broad, grooved and ridged; snout quite short and broad; eye large, with narrow adipose lid; mouth terminal, oblique, the lower jaw projecting; a narrow bony plate between the mandibles, attached to symphysis.

Teeth in villiform bands on both jaws, tongue, vomer, palatines. Maxillary broad and long, forming lateral part of mouth and reaching beyond posterior margin of eye; gill openings very large; gill rakers of first branchial arch longer than gill filaments, slender, rigid; those of other arches very short.

Scales large; a long pointed scale in axil of both pectorals and ventrals. Lateral line prominent, with branched tubules.

Origin of dorsal a little behind that of ventrals and midway between tip of snout and base of caudal; its upper edge concave, the last ray elongate; anal fin rather low, with concave margin, its length 1½ times that of dorsal; basal portion of fin scaled; caudal deeply lobed, somewhat longer than head; pectorals small, thoracic. Ventrals small, their origin about midway between origin of pectoral and that of anal.

Color, back and top of head dusky olive, other parts pale, silvery; margin of each scale of a brilliant silver; fins brownish.

This species is here described from a single small specimen obtained at Naha, in the Okinawa or Riu Kiu Islands, received from the Imperial Museum of Tokyo. It has not been hitherto recorded from Japan. It is common throughout the East Indian region, often entering streams and pools.

(κυπρῖνος, carp; εἶδος, resemblance.)

2. ELOPS Linnæus.

Elops Linnæus, Syst. Nat., 12th ed., 1766, p. 518 (*saurus*).
Mugilomorus Lacépède, Hist. Nat. Poiss., V, 1803, p. 398 (*anna-carolina*).
Trichonotus Rafinesque, Analyse de la Nature, 1815, p. 88 (*anna-carolina*); substitute for *Mugilomorus*, considered objectionable.

Body elongate, covered with thin, small, silvery scales. Dorsal fin slightly behind ventrals, its last rays short, the fin depressible into a sheath of scales; anal fin smaller, similarly depressible; pectorals and ventrals moderate, each with a long accessory scale. Opercular bones thin, with expanded, membraneous borders; a scaly occipital collar. Lateral line straight, its tubes simple. Pseudobranchiæ present, large. Vertebræ 66 to 72. One species known, a large fish of the open sea remarkable for the development of scaly sheaths. The young are ribbon-shaped and elongate, passing through a series of changes like those seen in *Albula*.

(ἔλοψ, name of some sea fish; a swordfish or sturgeon; from ἐλαύνω, to drive or move.)

2. ELOPS SAURUS Linnæus.

Elops saurus Linnæus, Syst. Nat., 12th ed., 1766, p. 518 (Carolina).—Günther, Cat., VII, 1868, p. 470 (Cuba, Jamaica, St. Croix, South America, Cape of Good Hope, Zanzibar, Djidda, Pinang, China).—Ishikawa, Prel. Cat., 1897, p. 8 (Miyako, Riu Kiu Islands).—Jordan and Evermann, Fishes North and Mid. Amer., I, 1896, p. 410; Fishes of Hawaiian Islands, 1905, p. 53, fig. 8, and of most authors.

Argentina carolina Linnæus, Syst. Nat., 12th ed., 1766, p. 519 (Carolina) (on the *Harengus minor bahamensis* of Catesby).

Argentina machnata Forskål, Descr. Anim., 1775, p. 68 (Djidda, Arabia).

Elops machnata Jordan and Evermann, Proc. U. S. Nat. Mus., 1902, XXV, p. 327 (Suwata, Formosa).

Mugilomorus anna-carolina LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 398 (South Carolina).

Elops inermis MITCHILL, Trans. Lit. and Phil. Soc. N. Y., I, 1815, p. 445 (New York).

Elops indicus SWAINSON, Class. Fish., II, 1839, p. 292, (after Inagow of Russell, Fishes of Vizagapatam, II, 1803, p. 63, fig. 179, nonbinomial) (Vizigapatam).

Elops capensis SMITH, Zool. S. Africa, 1845, pl. VII (Cape of Good Hope).

Elops purpurascens RICHARDSON, Ichth. China, 1846, p. 311 (Canton).

Habitat.—Tropical seas generally, north to southern Japan.

Head 3.75; depth about 5; D. 25 (including 7 rudiments); A. 16; P. 18; V. 15; vertebræ 66; scales 14–96–17, counting to middle of belly; eye nearly 5 in head, and equal to snout or interorbital space; mouth a little over 1.75 in head; pectoral 1.75; ventral a little more than pectoral, less than 2; least depth of caudal peduncle 3 in head.

Body elongate, compressed; head compressed, elongate, pointed; snout short, pointed, more or less rounded above; eye rather large, with broad adipose eyelid covering most of eye, except pupil; maxillary very long, expanded backward beyond the eye, with several longitudinal ridges; teeth in broad patches or bands in the jaws, along

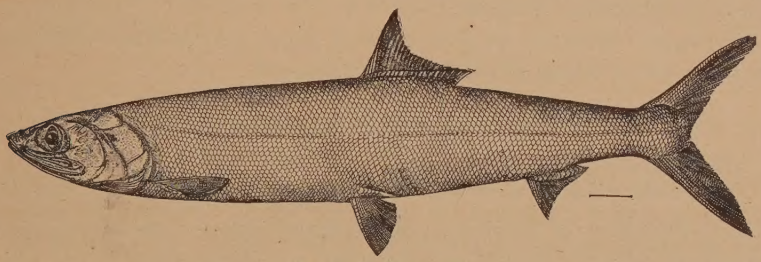

FIG. 1.—ELOPS SAURUS.

edge of maxillary and on vomer and palatines; tongue large, rather long, free in front; nostrils close together; interorbital space flattened, ridged.

Gill openings large; gill rakers 8+5 long, the outer portion more or less slightly expanded or enlarged; intestine straight, without convolutions; peritoneum silvery.

Scales small, uniform; bases of dorsal and anal with broad scaly sheaths; pectoral with scaly flap more than half length of head; ventral flap scaly, more than half length of fin; lateral line continuous; origin of dorsal nearer base of caudal than tip of snout, slightly behind base of ventrals, the anterior rays elevated; origin of anal a little behind tip of dorsal, the anterior rays longest; caudal deeply forked, lobes pointed; pectoral rather short, reaching scarcely halfway to origin of ventrals; ventrals a little shorter than pectorals, reaching more than halfway to anal.

Cosmopolitan, in the warmer seas. We have seen no specimens from Japan, but the species doubtless strays into Nagasaki, as into almost all other tropical and semitropical ports.

(σαῦρος, lizard.)

Family II. PTEROTHRISSIDÆ.

Body oblong, with rounded abdomen, covered with small cycloid scales; head narrow, oblong, naked, without barbels; muciferous channels much developed. Eye large; mouth inferior, small; margin of the upper jaw formed by the premaxillaries mesially, and by the maxillaries laterally; bands of minute teeth embedded in the thick lips; maxillary with a marginal row of very small teeth. Opercular apparatus complete. Lateral line present. No adipose fin; dorsal fin much elongate, many rayed; anal fin short; caudal fin forked, with dense layer of small scales. Stomach with a blind sac; pyloric appendages numerous. Gill apparatus well developed; pseudobranchiæ present; gill openings wide. Air bladder with very thick walls, terminating in 2 short horns in front, pointed behind. Ova very small; ovaries without duct.

The family is represented by a single genus and species, occurring off the coast of Japan in rather deep water.

3. PTEROTHRISSUS Hilgendorf.

Pterothrissus HILGENDORF, Leopoldina, XIII, 1877, p. 127 (*gissu*).
Bathythrissa GÜNTHER, Ann. Mag. Nat. Hist., p. 443, November, 1877 (*dorsalis*).

The characters of the genus are included above. Several extinct genera are referred to the neighborhood of *Pterothrissus*.

(πτερόν, wing; θρίσσα, herring.)

3. PTEROTHRISSUS GISSU Hilgendorf.

GISU.

Pterothrissus gissu HILGENDORF, Leopoldina, Pt. 13, 1877, p. 127 (off Tokyo).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 743 (Hakodate, Japan).—JORDAN and STARKS, Bull. U. S. Fish Comm. for 1902, p. 578 (Matsushima Bay, Suruga Bay).
Bathythrissa dorsalis GÜNTHER, Ann. Mag. Nat. Hist., November, 1877, p. 443.—GÜNTHER, Shore Fishes, Challenger, 1880, p. 63 (Enoshima).

Habitat.—Coasts of Japan, in rather deep water.

Head 4 in length, without caudal, 4½ to 4⅘ in total length; depth, about 6½ (7⅗ in total length); dorsal rays about 60. Counting the first two minute spines, we find the rays in our specimens as follows: 56, 57, 57, 58, 60, 64, 65; A. 12; P. 16; V. 10; scales in lateral series about 112; eye large, prominent, 3½–4 in head; snout, 3 in head; pectoral, 1⅘; ventral, 2⅓; least depth of caudal peduncle, 4½ to 5.

Body elongate, rather slender, the caudal peduncle markedly so; head low, large, the top broad, flattened, orbital ridges projecting above sides of interorbital space; snout long, conical, pointed, projecting considerably beyond mouth, with a median ridge above; beneath this a broad muciferous channel; a large keeled muciferous channel on side of head, extending from above mouth backward below and behind eye, there connecting with the channel on top of head; a sharp ridge running from lower lip backward almost to angle of opercle; mouth inferior, small, the short and broad maxillary reaching to a line extended vertically from the nostrils; jaws with bands of minute teeth.

Gill openings large, membranes united; gill rakers short, stout, papillate or tuberculate, present on all arches; pseudobranchiæ present.

Scales small, cycloid, easily detached; head naked; caudal basally covered with fine scales.

Our numerous specimens are from Suruga Bay, Matsushima Bay, Tsugaru Straits, and Hakodate. The largest is about 14 inches long. It is found in rather deep water in abundance.

(*gisu*, the local name, also applied to species of *Sillago*, of somewhat similar form.)

Family III. ALBULIDÆ.

Body rather elongate, little compressed, covered with rather small, brilliantly silvery scales; head naked. Snout conic, subquadrangular, shaped like the snout of a pig, and overlapping the small, inferior, horizontal mouth. Maxillary rather strong, short, with a distinct supplemental bone, slipping under the membranous edge of the very broad preorbital; premaxillaries short, not protractile. Lateral margin of upper jaw formed by the maxillaries; both jaws, vomer, and palatines with bands of villiform teeth; broad patches of coarse, blunt, paved teeth on the tongue behind and on the sphenoid and pterygoid bones. Eye large, median in head, with a bony ridge above it, and almost covered with an annular adipose eyelid. Opercle moderate, firm; preopercle with a broad, flat, membranaceous edge, which extends backward over the base of the opercle. Pseudobranchiæ present. Gill rakers short, tubercle-like. Gill membranes entirely separate, free from the isthmus; branchiostegals about 14; a fold of skin across gill membranes anteriorly, its posterior free edge crenate; no gular plate. Lateral line present. Belly not carinate, flattish, covered with ordinary scales. Dorsal fin moderate, in front of ventrals, its membranes scaly; no adipose fin; anal very small; caudal widely forked. Pyloric cœca numerous. Parietal bones meeting along top of head. Vertebræ numerous, 42+28=70. A single species among living fishes, found in all warm seas. In this, and probably in related families, the young pass through a metamorphosis, analogous to that seen in the conger

eels. They are for a time elongate, band shaped, with very small head and loose transparent tissues. From this condition they become gradually shorter and more compact, shrinking from 3 or 3½ inches in length to 2 inches. According to Doctor Gilbert, this process, like that seen in various eels, is a normal one, through which all individuals pass. In the Gulf of California, where these fishes abound, these band-shaped young are often thrown by the waves on the beach in great masses.

4. ALBULA Gronow.

Conorhyncus Nozeman, Act. Select., III, 1757, p. 382 (nonbinomial).
Albula Gronow, Zoöphyl., 1763, p. 102 (nonbinomial).
Albula Bloch and Schneider, Syst. Ichth., 1801, p. 432 (*conorhyncus=vulpes*).
Butyrinus Lacépède, Hist. Nat. Poiss., V, 1803, p. 45 (*banana=vulpes*).
Glossodus Cuvier, in Agassiz, Spix, Pisc. Bras., 1829, p. 48 (*forskâli=vulpes*).

Characters of the genus included above.
(*albus*, white.)

4. ALBULA VULPES (Linnæus).

Vubarana Marcgrave, Hist. Bras., 1648, p. 154 (Brazil).
Vulpes bahamensis [the Bone-fish] Catesby, Nat. Hist. Carolinas, etc., 1737, pl. II, fig. 1. (Bahamas).
Esox vulpes Linnæus, Syst. Nat., 10th ed., 1758, p. 313 (Bahamas; based on the Bone-fish, *Vulpes bahamensis*, of Catesby).
Argentina glossodonta Forskâl, Descr. Anim., 1775, p. 68 (Djidda, Arabia).
Macabí Parra, Dif. Piezas, Cuba, 1787, p. 88, pl. XXXV, fig. 1 (Cuba; based on *Vubarana* of Marcgrave).

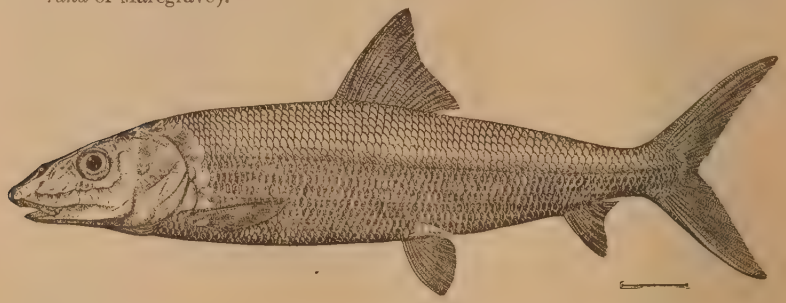

Fig. 2.—Albula vulpes.

Synodus argenteus Bloch and Schneider, Syst. Ichth., 1801, p. 398 (Asia).
Clupea brasiliensis Bloch and Schneider, Syst. Ichth., 1801, p. 427 (Brazil).
Albula conorynchus Bloch and Schneider, Syst. Ichth., 1801, p. 432 (Antilles; after Gronow and Plumier; called *Albula plumieri* on plate LXXXVI).
Amia immaculata Bloch and Schneider, Syst. Ichth., 1801, p. 451 (Central America; after *Macabi* of Parra).
Butyrinus banana Lacépède, Hist. Nat. Poiss., V, 1803, p. 46 (Ile de France).
Clupea macrocephla Lacépède, Hist. Nat. Poiss., V, 1803, p. 426 (Martinique, on a drawing by Plumier).
Glossodus forskâli Agassiz, Spix, Pisc. Bras., 1829, p. 49 (Bahia; called *Engraulis sericus* and *Engraulis bahiensis* on plates XXII and XXIV).

Albula parræ CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 339 (Martinique, Bahia, Rio de Janeiro).

Albula goreensis CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 342 (Gorea).

Albula neoguinaica CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 350 (New Guinea).

Albula seminuda CUVIER and VALENCIENNES, Hist. Nat. Poiss, XIX, 1846, p. 351 (New Guinea).

Albula erythrocheilos CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 352, pl. CXL (Tonga).

Albula forsteri CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, p. 354 (Tahiti).

Albula rostrata GRONOW, Cat. Fishes, 1854, p. 189 (American ocean, etc.).

Albula conorhynchus GÜNTHER, Cat. VII, 1868, p. 468.

Albula vulpes JORDAN and GILBERT, Synopsis, 1883, p. 258.—JORDAN and EVERMANN, Fish. North Mid. Am., I, 1898, p. 411.—JORDAN and EVERMANN, Fishes of Hawaiian Islands, 1903 (1905), p. 55, fig. 9 (Honolulu, Hilo).

Habitat.—Shores of all tropical seas.

Head $3\frac{2}{3}$; depth 4. D. 15; A. 8; scales 9–71–7. Upper lobe of caudal the longer. A broad band of peculiar, elongate, membranaceous scales along middle line of back; accessory ventral scale large. Brilliantly silvery; olivaceous above; back and sides with faint streaks along the rows of scales; fins plain; axils dusky. Length 18 inches to 3 feet. Tropical seas, on sandy coasts, almost universally distributed and generally abundant, ranging northward to Nagasaki in Japan. One specimen found in the Tokyo market.

(*vulpes*, fox.)

Family IV. CHANIDÆ.

Body oblong, compressed, covered with small, firm, adherent scales. Lateral line distinct. Abdomen broad and flattish. Snout depressed; mouth small, anterior, the lower jaw with a small symphyseal tubercle; no teeth; premaxillary joined to upper anterior edge of maxillary. Eye with an adipose eyelid. Gill membranes broadly united, free from the isthmus. Branchiostegals 4; pseudobranchiæ well developed; an accessory branchial organ in a cavity behind the gill cavity. Dorsal fin opposite the ventrals; anal fin shorter than dorsal. Mucous membrane of esophagus raised into a spiral fold; intestine with many convolutions. Skeleton with various peculiarities. Coloration silvery. Vertebræ about 45. Large fishes of the warmer parts of the Pacific.

5. CHANOS Lacépède.

Chanos LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 395 (*arabicus*).

Lutodeira (KUHL) RÜPPELL, Neue Wirbelthiere, 1835, p. 18 (*chanos*).

Ptycholepis GRAY, Dieffenbach's Travels in New Zealand, II, p. 218, about 1842 (*salmoneus*).

Characters of the genus included above.

(χάνος, name in modern Greek, from χάνος, the open mouth).

5. CHANOS CHANOS (Forskål).

Mugil chanos FORSKÅL, Descript. Anim., 1775, p. 74 (Red Sea; Djidda, Arabia).

Lutodeira chanos RÜPPELL, Atlas Nordl. Africa, 1828, p. 18, pl. v, fig. 1 (Red Sea).

Chanos chanos KLUNZINGER, Verh. Bat. Zool. Gen., Wien, 1871, p. 605.—JORDAN and EVERMANN, Fishes North and Mid. America, I, 1896, p. 414; Fishes of Hawaiian Islands, p. 56, 1903 (1905) fig. 10, (Hawaiian Islands); Proc. U. S. Nat. Mus., XXV, 1902, p. 327 (Giran, Taihoku and Toii, Formosa).

Mugil salmoneus (Forster) BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 121 (Pacific Ocean).

Chanos salmoneus CUVIER and VALENCIENNES, Hist. Nat. Poiss., 1846, p. 201 (Between New Caledonia and Norfolk Island).

Leuciscus (*Ptycholepis*) *salmoneus* GRAY, in Dieffenbach Trav. New Zeal., II, p. 218 (New Zealand).

Chanos arabicus LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 396 (Arabia).

Cyprinus pala CUVIER, Règne Animal, 2d ed., II, 1829, p. 276 (India) (After Russell).

Cyprinus tolo CUVIER, Règne Animal, 2d ed., II, 1829, p. 276 (India).

Leuciscus zeylonicus BENNETT, Proc. Comm. Zool. Soc., 1832, p. 184 (Ceylon).

Chanos mento CUVIER and VALENCIENNES, Hist. Nat. Poiss., XIX, 1846, pp. 194–198 (Ile de France, *chloropterus* Madipolam, *nuchalis* Vizigapatam, *orientalis* Japan, and *cyprinella* Honolulu).

Butirinus argenteus JERDON, Madras, Journ. Lit. Sci., XV, 1849, p. 343 (Madras).

Butirinus maderaspatensis JERDON, Madr. Journ. Lit. Sci., XV, 1849, p. 344 (Madras).

Chanos indicus BLEEKER, Verh. Bat. Gen., XXIV, 1852, p. 11 (East Indies).

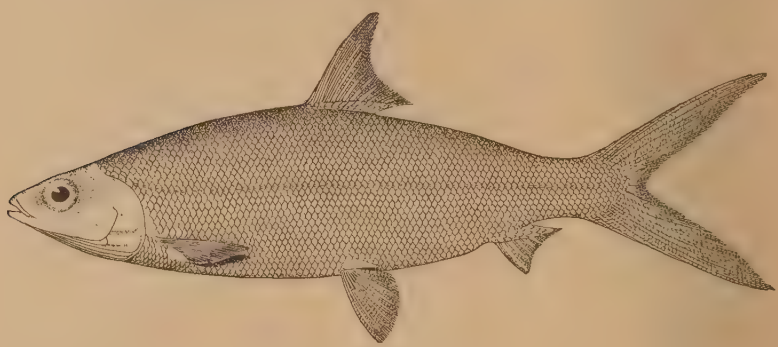

FIG. 3.—CHANOS CHANOS.

Habitat.—Tropical shores of the Pacific, north to southern Japan. Head $4\frac{2}{5}$; depth 4. D. II, 12; A. II, 9; scales 12–86–14. Vertebræ $19+26=45$; snout $3\frac{1}{2}$; eye $3\frac{1}{2}$; maxillary $4\frac{1}{3}$. Pectoral $1\frac{3}{5}$; ventral $1\frac{1}{5}$; caudal $\frac{1}{3}$ longer than head; dorsal $1\frac{1}{4}$ in head. B. 4. Aspect of a large Cyprinoid. Body elliptical, moderately compressed, the caudal peduncle slender. Head pointed, rounded above. Eye and side of head covered by a large transparent, imperforate adipose eyelid. Mouth small, terminal toothless, transverse, the lower jaw included; maxillary broad, slipping under the adipose preorbital, without sup-

plemental bone. Opercle truncate behind. Pseudobranchiæ very large. Gill-rakers fine and flexible, very close set, rather long. Bones of gill-rakers flexible. Gill arches all connected by membrane. Lateral line well developed. Scales firm, cycloid, with strongly marked longitudinal striæ. Scales rather large, hard, firm, enameled, becoming bony when dry, used by the Indians for ornamental work. Dorsal inserted somewhat nearer snout than base of caudal, before ventrals, its first ray falcate, its last produced in a short filament, longer than pupil; base of fin with a large scaly sheath; pectoral and ventral with scaly axillary appendage; anal similar to dorsal but much smaller; pectorals and ventrals rather small; caudal very long, forked to the base, its lobes subequal, straight; base of fin with small scale; ventrals somewhat falcate. Color greenish above, the sides brilliantly silvery, fins more or less darkened; inside of ventrals and pectorals blackish. Length 2 to 5 feet. Pacific and Indian oceans, on sandy shores, north to the Hawaiian Islands and to Nagasaki; not seen by us in Japan, but almost everywhere common in the tropical Pacific.

Family V. DOROSOMATIDÆ.

Body short and deep, strongly compressed, covered with thin, deciduous, cycloid scales. Belly compressed to an edge, which is armed with bony serratures. Head naked, short, rather small. Mouth small, inferior, oblique, overlapped by the blunt snout; no teeth; maxillary narrow and short, with a single supplemental bone, not extending to opposite middle of eye, and forming but a small portion of lateral margin of upper jaw; mandible short and deep, its rami enlarged at base; premaxillaries not protractile. Gill-rakers slender, exceedingly numerous, not very long, similar on all the arches. Gill membranes not united, free from the isthmus; branchiostegals about 6; pseudobranchiæ large. An adipose eyelid. No lateral line. Dorsal fin about midway of the body, usually behind ventrals. Pectorals and ventrals moderate, each with an accessory scale. Anal very long and low; caudal forked. No adipose fin. Vertebræ 49. Stomach short, muscular, like the gizzard of a fowl. Mud-eating fishes of the coasts and rivers of warm regions, of little value as food. The family is very close to the Clupeidæ, the distinguishing characters being not of great importance.

KEY TO GENERA.

a. Dorsal fin with its last ray prolonged and filamentous.

b. Mouth large; gillrakers very long; anal fin very low..... *Konosirus*, 6

6. KONOSIRUS Jordan and Snyder.

Konosirus JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 349 (*punctatus*).

This genus is closely related to *Dorosoma*, the American Gizzard Shad, differing in the larger mouth, longer gill-rakers, and in the very low anal fin.

The dorsal, as in *Dorosoma*, has its last ray produced in a long filament. Species Asiatic, entering rivers.

(*Konoshiro*, the Japanese name, from the Castle of Konoshiro, *kono*, virtue; *shiro*, castle; in allusion to the barred markings, like the castle gates.)

KEY TO SPECIES.

a. Snout little longer than lower jaw; depth about $3\frac{1}{3}$ in length, without caudal; anal rays 22 to 24; scales 55; a dark opercular spot and dark streaks along the rows of scales above ..... *punctatus*, 6

aa. Snout very prominent, projecting much beyond lower jaw; depth $2\frac{1}{3}$ in length, without caudal; anal rays 20 to 22; scales 50; color silvery, with a dark opercular spot; bluish above; rows of spots along sides of back indistinct or wanting ..... *nasus*, 7

6. KONOSIRUS PUNCTATUS (Schlegel) Jordan and Snyder.

KONOSHIRO.

Chatoëssus punctatus SCHLEGEL, Fauna Jap. Poiss., 1846 p. 240, pl. CIX, fig. 1 (Nagasaki).—CUVIER and VALENCIENNES, Hist. Nat. Poiss., XXI, 1848, p. 107 (Japan).—BLEEKER, Verh. Bat. Gen., XXV, Japan, p. 50.—KNER, Novara Fische, 1867, p. 336 (Madras, Tahiti).—GÜNTHER, Cat. Fish., VII, 1868, p. 408.—NAMIYE, Class. Cat., 1881, p. 109 (Tokyo).—ISHIKAWA, Prel. Cat., 1897, p. 9 (Tokyo; Boshu, Japan).

Konosirus punctatus JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 327 (Tokyo); Check list, 1901, p. 52 (Yokohama).

Clupanodon thrissa JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 743 (Yokohama; not *Clupea thrissa* of Osbeck, a Chinese species).

Habitat.—Shores of southern Japan, entering estuaries.

Head 4 in length ($4\frac{2}{3}$ in total length); depth $3\frac{1}{4}$ ($3\frac{2}{3}$); D. 16, A. 23; P. 16; V. 8; scales in lateral series, 55; eye space 4 in head; eye 6; interorbital space $4\frac{1}{3}$ in head; mandible $2\frac{2}{3}$; pectoral $1\frac{1}{2}$; ventral $2\frac{1}{2}$; caudal peduncle compressed, about 3.

Body deep compressed, elliptical ovate; the belly more curved than back; body less elevated than in species of *Dorosoma;* throat and belly sharp, margined by scutes terminating in sharp spines which point backward; head rather small, conical, rather broad above, the interorbital space with a blunt median ridge; snout blunt, quite short, broad; eye space large, pointed anteriorly, all but pupil of eye covered by an adipose lid; mouth subterminal, slightly inferior, the premaxillaries projecting slightly beyond cleft, medium size, larger than in the American species, *Dorosoma cepedianum;* mandible extending to posterior margin of eye space; maxillary well developed posteriorly, reaching to middle of orbit; opercular membrane bones broad, well

developed; numerous branching mucous canals radiating behind and below eye.

Teeth none.

Gill-openings large, membranes free from isthmus; gillrakers of first arch very fine and slender, as long as gill filaments, which are coarser and stouter than rakers; all the gill arches with well developed gillrakers; pseudobranchiæ numerous, coarse.

Scales thin, close set, not deciduous, medium size, cycloid; a long, narrow, pointed scale in axil of ventral and pectoral.

Lateral line not present.

Distance from tip of snout to base of dorsal a trifle more than from posterior end of dorsal to middle of base of caudal; fin moderately high forward, rapidly decreasing in height till last ray is reached; this is filamentous and greatly elongated, reaching base of caudal; anal fin low, slightly longer than dorsal; caudal of medium size, deeply emarginate; pectoral moderate; ventral small, its origin beneath middle of dorsal.

Color dorsal region brownish olive, with a silvery cast; each scale on back and to middle of sides with a brown spot in middle; a large black blotch on shoulder, opposite or higher than eye; sides and belly yellowish silvery; fins uniform, pale brown or yellowish.

This description is taken from specimens from Tokyo. We have others from Nagasaki, and from Matsushima Bay. It is rather common in southern Japan.

The related species (*Konosirus thrissa* Osbeck and *Konosirus nasus* (Bloch) = *Chatoëssus aquosus* Richardson) occurs in southern China, but there is no trustworthy record of their existence in Japan. It is not known that *Konosirus punctatus* occurs in China.

(*punctatus*, spotted.)

7. KONOSIRUS NASUS (Bloch).

DOROKUI (MUD CARP).

Clupea nasus Bloch, Ichthyologia, XII, 1797, p. 117, pl. cccxxix (Tranquebar).
Chatoessus nasus Cuvier and Valenciennes, Poiss., XXI, 1848, p. 104 (Pondicherry, Bombay).—Günther, Cat., VII, 1868, p. 407 (Cochin, Java, Amboyna, Philippines).
Dorosoma nasus Bleeker, Atlas Ichth. Clup., VI, p. 142; pl. cclx, fig. 4 (East Indies).
Konosirus nasus Smith and Pope, Proc. U. S. Nat. Mus., XXXI, 1906, p. 462 (Urado near Kochi).
Clupanodon nasicus Lacépède, Poiss., V, 1803, p. 472 (After Bloch).
Chatoessus altus Gray, Illustr. Ind. Zool., 1835, pl. xci, fig. 2 (India).
Chatoessus aquosus Richardson, Ichth. China, 1846 (Canton).
Chatoessus come Richardson, Voy. Erebus and Terror, 1846, p. 62, pl. xxxi.
Konosirus thrissa Jordan and Seale, Proc. Davenport Ac. Sci., X, 1905, p. 2 (Hong Kong; not *Clupea thrissa* Linnaeus).[a]

[a] The name *Clupea thrissa* Linnæus, based primarily on the *Clupea trizа* of Lagerström and *Clupea thrissa* of Osbeck, seems to belong to the remaining Chinese species, distinguished by the long anal fin (A. 26 to 28). This should stand as

Habitat.—East Indies, north to southern Japan.

Head 4; depth 2⅓ to 2⅔; D. 16, A. 20–22 (besides two rudiments); scales 19–46 to 50; eye 4 in head, about as long as snout; gape twice as wide as deep, overhung by the snout; gill rakers rather short; abdominal scutes 15+13.

Silvery, bluish above, the middle of each row of scales above darker, this forming faint longitudinal streaks above; usually a blackish spot behind opercle; dorsal and caudal dusky behind.

This species, common on the coasts of China and south to India and the East Indies, has been once taken in Japan, three specimens being secured at Urado near Kochi in Shikoku by Dr. Hugh M. Smith.

Jordan and Seale were apparently in error in the identification of this species with *Clupea thrissa* Linnaeus. In the original diagnosis, quoted from Lagerström, 28 anal rays are counted. This number occurs in the Chinese species, *Konosirus maculatus* (Richardson), which species should stand as *Konosirus thrissa*. The *thrissa* of Lacepede, after Broussonet, the type of his genus *Clupanodon*, is the West Indian *Opisthonema*, or rather *Clupanodon oglinus*.

(*nasus*, nose.)

Family VI. CLUPEIDÆ.

HERRINGS.

Body oblong or elongate, more or less compressed, covered with cycloid or pectinated scales. Belly sometimes rounded, sometimes compressed, in which case it is often armed with bony serratures. Head naked, usually compressed. Mouth rather large, terminal, the jaws about equal; maxillaries forming the lateral margins of the upper jaw, each composed of about three pieces. Premaxillaries not protractile; teeth mostly small, often feeble or wanting, variously arranged. Adipose eyelid present or absent. Gillrakers long and slender; gill membranes not connected, free from the isthmus. No gular plate. Gills 4, a slit behind the fourth. Branchiostegals usually few (6 to 15). Posterior lower part of opercular region often with an angular emargination, the tips of the larger branchiostegals being abruptly truncate. Pseudobranchiæ present. No lateral line. Dorsal fin

KONOSIRUS THRISSA (Linnæus).

Mystus corpore ovato (*Clupea trizа*) LAGERSTRÖM, China, about 1750, p. 30 (China; A. 28).

Clupea thrissa OSBECK, Iter. Chinensis, 1757, p. 257 (China; A. 24; pre-Linnæn).

Clupea thrissa LINNÆUS, Syst. Nat., 10th ed., 1758, p. 318. (Diagnosis after Lagerström; name after Osbeck).

Chatoëssus osbecki CUVIER and VALENCIENNES, Poiss., XXI, 1848, p. 106 (China; snout much shorter than in *C. nasus;* body more oblong; A. 24; may be *K. punctatus*).

Chatessus trizа, *chrysopterus*, and *maculatus*, RICHARDSON, Ichth. China, pp. 307, 308 (Canton).

Chatoëssus maculatus GÜNTHER, Cat. VII, 1868, p. 409 (Formosa).

median or somewhat posterior, rarely wanting. No adipose fin. Ventrals moderate or small (wanting in *Pristigaster*). Anal usually rather long; caudal fin forked. Vertebræ 40 to 56. Species numerous, inhabiting all seas, and usually swimming in immense schools; many species ascend fresh waters, and some remain there permanently. The northern and fresh-water species, as in many other families, differ from the tropical forms in having a larger number of vertebral segments.

KEY TO GENERA.

a. (DUSSUMIERIINÆ.) Belly rounded, covered with ordinary scales; supplemental bones of maxillary very narrow; anal fin short.
b. Ventrals small; teeth small, persistent, on jaws, vomer, palatines, pterygoids, and tongue.
c. Dorsal inserted before ventrals; teeth moderate; no silvery lateral band; dorsal long, of 18 to 29 developed rays ..... *Etrumeus*, 7
cc. Dorsal opposite ventrals; teeth very feeble or wanting; a broad silvery lateral stripe ..... *Stolephorus*, 8
aa. Belly compressed, armed with bony serræ; supplemental bones of maxillary broad.
d. (CLUPEINÆ) Anal fin moderate, of 15 to 25 rays; dorsal inserted nearly opposite ventrals.
e. Scales with their posterior margins entire and rounded; intestinal canal of moderate length.
f. Last ray of dorsal not produced.
g. Vertebræ about 50 in number (46 to 56); species of nothern regions.
h. Vomer with teeth; ventral scutes weak, ventrals below middle of dorsal; vertebræ 50 to 56. Skeleton rather firm.... *Clupea*, 9
hh. Vomer without teeth; ventral scutes very weak, the belly more or less rounded; vertebræ about 52; ventrals under middle of dorsal. Skeleton weak, flesh oily ..... *Sardinella*, 10
gg. Vertebræ about 42 (40 to 44); tropical species with the scales large and usually firmly attached; ventrals inserted under middle of dorsal; adipose eyelid obsolete ..... *Harengula*, 11
dd. (PRISTIGASTERINÆ.) Anal fin very long, of more than 30 rays; dorsal fin inserted behind ventrals.
ii. Teeth all villiform; no canines; ventral fins present. *Ilisha*, 12

7. ETRUMEUS Bleeker.

Etrumeus BLEEKER, Verh. Bat. Gen., XXV, Japan, 1853, p. 58 (*micropus*).
Perkinsia ROSA SMITH, Amer. Nat., 1891, p. 153 (*othonops*).

Body rather elongate, somewhat compressed, the abdomen rounded and without serratures. Mouth terminal, of moderate width, formed as in *Clupea*, but the maxillary more slender. Teeth moderate, in patches on jaws, palatines, pterygoids, and tongue. Scales cycloid, entire, very deciduous. Branchiostegals numerous, very slender. Ventrals inserted posteriorly, entirely behind dorsal; the dorsal fin rather long, of 18 to 20 rays; anal low, of moderate length. Pseudobranchiæ well developed; pyloric cœca numerous. No silvery lateral stripe. Few species. Asiatic and American.

(*urume*, Japanese name of *Etrumeus micropus*, called by Bleeker *Ikan etrumei*.)

8. ETRUMEUS MICROPUS (Schlegel).

URUMEIWASHI.

Clupea micropus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 236, pl. CVII, fig. 2 (Nagasaki).

Etrumeus micropus BLEEKER, Verh. Bat. Gen., XXV, 1853, p. 48 (Nagasaki).—GÜNTHER, Cat., VII, 1868, p. 467 (Japan).—NAMIYE, Class. Cat., 1881, p. 109 (Tokyo).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Tokyo).—JORDAN and EVERMANN, Bull. U. S. Fish Com., XXIII for 1903, p. 58 (Honolulu).

Perkinsia othonops ROSA SMITH EIGENMANN, Amer. Nat., 1891, p. 153 (San Diego, California).

Habitat.—Sandy shores of southern Japan; also ranging to Hawaii, and once recorded from California.

Head 4 to $4\frac{2}{3}$ in length; depth 6 to $6\frac{1}{2}$; D. 20; A. 11; P. 16 or 17; V. 9; scales about 56; eye 3 in head; snout 3.5; mandibles 2; interorbital space 4 to $4\frac{1}{3}$; maxillary $2\frac{3}{4}$ to 3; P. 1.5 in head; V. $2\frac{2}{3}$; caudal peduncle compressed, its least depth $3\frac{1}{4}$ in head.

Body elongate, subcylindrical, slightly compressed; head elongate, much compressed anteriorly, pointed, flattened above; snout long, pointed, compressed; eyes large, covered by thick, adipose eyelids; mouth small, terminal, jaws subequal, the mandible projecting very slightly; teeth in jaws minute; in fine villiform bands on vomer, palatines, and tongue. Maxillary slipping under the preorbital ridge and extending posteriorly a little beyond the anterior edge of eye; preopercle with radiated branching mucous caudals present; gill openings large, membranes free from isthmus; gill rakers long, slender; gill filaments longer, fine, the pseudobranchiæ also long; peritoneum pale or silvery; scales rather large, cycloid, mostly falling off in alcoholic specimens; both pectorals and ventrals with long pointed scaly flaps but little shorter than the fins. Origin of dorsal nearer tip of snout than base of caudal; anal fin very small, its origin midway between origin of ventrals and base of caudal; caudal small, deeply emarginate; pectorals rather short, about $2\frac{1}{2}$ in space to ventrals; ventrals small, their origin behind tip of depressed dorsal, 2 in space to origin of anal.

Color dusky blue above, often with rows of darker blotches, the lower parts silvery white; tips of snout and mandible dusky; fins yellowish to pale or whitish; basal portions of pectoral and caudal more or less dusky.

This species is common throughout southern Japan in sandy bays. Many specimens were taken at Nagasaki, Wakanoura, Misaki, Aomora, and Tokyo.

(*μικρός*, small; *πούς*, foot.)

8. STOLEPHORUS Lacépède.

Stolephorus LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 381 (*japonicus*) (not *Stolephorus* Bleeker=*Anchovia*).
Clupeoides BLEEKER, Verh. Bat. Gen., XXIV, p. 17 (*macassariensis=delicatula*).
Spratelloides BLEEKER, Verh. Bat. Gen., XXIV, p. 29 (*argyrotænia=japonica*).

Body oblong, little compressed, with rather large, thin, deciduous scales. Belly rounded, without serrature. Snout conical, compressed, formed much as in *Clupea*. Teeth none or very minute and deciduous. Anal fin short, free from caudal, its rays 9 to 15. Gill membranes separate. Dorsal inserted opposite ventrals. About 6 flat branchiostegals.

Small fishes of the Indian seas, marked with a broad silvery lateral band, as in the species of *Engraulis* and *Anchovia*, a fact which led to the erroneous identification of the name *Stolephorus* with species of the latter genus. The name, however, should not be used for any anchovy.

(στολή, a stole, a white band worn by priests; φόρος, bearing; in allusion to the silvery lateral band.)

9. STOLEPHORUS JAPONICUS (Houttuyn.)

KIBUNA IWASHI.

Atherina japonica HOUTTUYN, Verh. Holl. Maatsch. wet Haarl., XX, 1782, Pt. 2, p. 340 (Nagasaki).
Stolephorus japonicus LACÉPÈDE, Hist. Nat. Poiss., V., 1803, p. 381, after Houttuyn.—JORDAN and SEALE, Proc. U. S. Nat. Mus., XXVIII, 1905, p. 770 (Negros I., Philippines).
Clupea gracilis SCHLEGEL, Fauna Japon. Poiss., 1846, p. 238, pl. CVIII, fig. 2 (Nagasaki).
Spratelloides gracilis GÜNTHER, Cat., VII, 1868, p. 465 (Japan).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Hizen).
(?) *Spratelloides argyrotænia* BLEEKER, Verh. Bat. Gen., XXIV, p. 29 (Celebes).

Habitat.—Southern Japan, north to Izu and Osaka, very common in sandy bays. Also in the East Indies, if *Stolephorus argyrotænia* is the same species.

Head about 4½ in length; depth about 7; D. 11; A. 13; P. 14; V. 8; eye, 3 in head; snout 4; mandible 2 to 2½; interorbital space 4½ to 5; ventral 2¼; caudal peduncle flattish, 3¼.

Body elongate, slender, subcylindrical; caudal peduncle and head compressed, the snout pointed; back broad, its transverse diameter about 2 in head; snout pointed; top of head flattened; eye large, with adipose lid; mouth terminal, rather small, the lower jaw very slightly projecting; maxillary comparatively broad, covering all but tip of mandible, and extending posteriorly to anterior margin of eyeball.

Teeth absent.

Gill opening large, the membranes free; gill rakers very fine and slender; gill filaments about two-thirds as long as gill rakers; pseudobranchiæ numerous. Peritoneum dusky.

Scales large, cycloid, deciduous; no lateral line; no ventral scutes or serrated scales.

Dorsal small, its origin slightly nearer tip of snout than base of caudal; anal low, very small, very far back; distance from its origin to that of caudal about one-fifth of length without caudal fin; caudal small, deeply emarginate; ventrals small, their origin beneath middle of dorsal; pectorals inserted at lower posterior angle of opercle.

Color, uniform pale brown bluish in life, with a broad lateral silvery band, this bordered with a narrow dusky band above; a narrow median dorsal dusky band from tip of snout to base of caudal. Fins colorless, except dorsal and caudal; these marked by fine transverse dusky lines.

This beautiful little fish is common throughout southern Japan in estuaries and sandy bays. We have many from Wakanoura, Nagasaki, Heda in Izu (Capt. Alan Owston), and from the mouth of the Yodo River, at Osaka. Specimens of *Stolephorus argyrotænia* from Negros Island in the Philippines seem to differ only in having no dark streak along the upper edge of the lateral stripe, this streak being conspicuous in all adult Japanese examples.

(*japonicus*, Japanese.)

9. CLUPEA (Artedi) Linnæus.

Clupea (Artedi) Linnæus, Syst. Nat., 10th ed., 1758, p. 317 (*harengus*).
Rogenia Cuvier and Valenciennes, Hist., Nat. Poiss., XX, 1847, p. 340 (*alba*, "the whitebait," the young of *harengus*).

True herrings with the body elongate, numerous vertebræ, the ventral serratures weak, and an ovate patch of small but persistent teeth on the vomer. The few species belong to the northern seas, where the number of individuals is inordinately great, exceeding perhaps those of any other genus of fishes. Not anadromous, spawning in the sea.

(*clupea*, herring).

KEY TO SPECIES.

a. Belly serrate behind ventrals only; anal rays about 14..... *pallasii*, 10

10. CLUPEA PALLASII Cuvier and Valenciennes.

NISHIN (HERRING).

Clupea harengus var. Pallas, Zoogr. Rosso.-Asiat., III, 1811, p. 209 (Kamchatka).
Clupea pallasii Cuvier and Valenciennes, Hist. Nat. Poiss., XX, 1847, p. 253 (Kamchatka; based on Pallas's specimens).
Clupea mirabilis Girard, Proc. Ac. Nat. Sci., Phila., 1854, p. 148 (San Francisco).—Günther, Cat., VII, 1868, p. 418.—Jordan and Gilbert, Synopsis, 1883, p. 265.

Spratelloides bryoporus COPE, Proc. Amer. Philos. Soc., 1873, p. 25 (Sitka).—JORDAN and GILBERT, Synopsis, 1883, p. 264.

Clupea harengus NAMIYE, Class. Cat., 1881, p. 108 (Hokkaido).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Nemuro, Hitachi, Sakhalin). (Not of Linnæus).

Habitat.—North Pacific, south to northern Japan and to southern California.

Head, 4⅛ in length; depth, 4; D. 16; A. 14; scales, 52; eye, 2.5 to 3 in length of head; snout, 4; mandible, 1¾; interorbital space, 5¾; maxillary, 2; caudal peduncle compressed, its least depth a little less than 3 in head.

Body elongate, posterior and anterior regions compressed; head much compressed in front of eyes; sides of snout bulging; eyes large, with large adipose eyelid; mouth terminal, oblique, rather small, the lower jaw strongly projecting.

Lower jaw armed with a few small teeth, none on premaxillary; tongue and vomer each with a small patch of minute teeth arranged in a double row. Mandible largely concealed by the large maxillary,

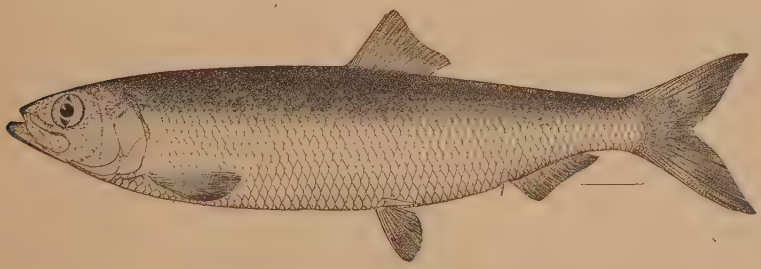

FIG. 4.—CLUPEA PALLASII.

which extends backward to middle of orbit or beyond. Top of head flattened, with a concavity behind interorbital region.

Gill openings quite large, the membranes free from isthmus; gill rakers very long, slender, numerous; pseudobranchiæ present; peritoneum dusky.

Scales deciduous, medium size, cycloid; scutes small, poorly developed, only between ventrals and anal.

Insertion dorsal almost midway between tip of snout and base of caudal, the fin small, its base a little less than half the length of head; anal low, its length equal to that of dorsal; caudal small, emarginate; pectorals small, 1½ in head; ventrals short, 2 in space to anal opening, their origin a little forward of middle of dorsal.

Color of alcoholic specimens: dusky above, sides and belly brassy or silvery; scales with a greenish opalescent luster. Fins brownish yellowish to pale.

This species, the common herring of the Pacific, is abundant in northern Japan, as throughout Alaska, and southward to southern California. About Sakhalin and Hokkaido the fisheries of Nishin or

herring have great economic importance. We have specimens from Aomori, Otaru, Matsushima, Kushiro, Same, Petropaulski (*Albatross*), and Hakodate.

10. SARDINELLA Cuvier and Valenciennes.

Sardinella CUVIER and VALENCIENNES, Poiss., XX, 1847, p. 261 (*aurita*).
Amblygaster BLEEKER, Jour. Ind. Arch., III, 1849, p. 72 (*clupeoides*).
Sardinia POEY, Memorias, II, 1860, p. 311 (*pseudohispanica*).

This genus is close to *Clupea*, which it resembles in the elongate form and weak ventral serratures, differing in the form of the body and in the feeble skeleton. Vomer toothless, the teeth in the jaws mostly weak. Scales thin, deciduous. Adipose eyelid present. Gill rakers very numerous. Species chiefly confined to the two temperate zones, all closely related to the European Sardine, *Sardinella pilchardus*, and agreeing with it in the rich and delicate flesh; less firm than that of related species and much richer in oil. Species marine, not anadromous, known in Japan as Iwashi or Sardine. As *Sardinella aurita*, the type of *Sardinella* seems to be a true sardine, *Sardinella* must take the place of *Sardinia*. *Clupanodon*, a name sometimes used for this group, is strictly a synonym of *Opisthonema*, and has priority over the latter name for the American genus.

(*sardinia*, a sardine.)

11. SARDINELLA MELANOSTICTA (Schlegel).

IWASHI (SARDINE).

Clupea melanosticta SCHLEGEL, Fauna Japon. Poiss., 1846, p. 237, pl. CVII, fig. 3 (Nagasaki).—GÜNTHER, Cat. Fish., VII, p. 430 (China, Japan).—NAMIYE, Class. Cat., 1881, p. 108 (Tokyo).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Tokyo, Nagasaki).
Clupanodon melanostictus JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1901, p. 349 (Tokyo).
(?) *Clupea cæruleovittata* RICHARDSON, Ichth. Chin., 1846, p. 305 (Canton).

Habitat.—Shores of southern Japan and China. The Chinese species *Sardinella cæruleovittata* is apparently the same, but Schlegel's name of the same date has page precedence.

Head, $4\frac{1}{3}$ to $4\frac{1}{2}$ in length to base of caudal; depth, 6 to 7; D., 16 to 17; A., 17; P., 17; V., 8; scales in lateral line about 45; eye, including adipose eyelid, 3 in head; snout, $4\frac{1}{2}$; mandible, $1\frac{3}{4}$; interorbital space, 5; maxillary, $2\frac{1}{5}$; P., $1\frac{1}{3}$ to $1\frac{2}{7}$ in head, 8 in total length; V., $2\frac{2}{3}$ in head; caudal peduncle rounded, its least depth $3\frac{3}{4}$ in head.

Body elongate, subcylindrical; head elongate, compressed, pointed, slightly flattened above; snout rather short and blunt. Eye large, covered by the thick adipose eyelid; mouth small, terminal somewhat oblique, the lower jaw projecting. Teeth wanting, except on tongue, which is covered with bands of excessively minute teeth, and a median row of larger, but still very small teeth. Maxillary extending poste-

riorly to a perpendicular drawn from middle of orbit. Gill openings large, membranes free from isthmus; gill rakers numerous, slender, close set, twice as long as gill filaments; pseudobranchiæ shorter than gill filaments; peritoneum dark or black.

Scales very thin, deciduous, ctenoid; or median abdominal line a series of scutes from isthmus to anus, each prolonged backward into a sharp point.

Origin of dorsal nearer tip of snout than base of caudal, its base about 7 in body without tail; distance from snout to origin of dorsal equals that from posterior end of its base to base of caudal; anal longer than dorsal, its origin midway between that of ventrals and base of caudal; caudal deeply emarginate; pectorals abdominal, about $1\frac{2}{3}$ in head; ventrals small, their origin under middle of dorsal.

Color lustrous; bluish above, sides and belly silvery white; a row of bluish-black spots or blotches more or less evident along sides; fins pale or yellowish.

This species is the common sardine of Japan, entirely similar in habits and economic value to its homologues in America and Europe. We have specimens from Hakodate, Tokyo, Yokohama, Tsuruga, Aomori, Misaki, Same, Tateyama, Matsushima Bay, Wakanoura, Kobe, Onomichi, Hakata, and Nagasaki.

(*μέλας*, black; *στικτός*, spotted).

11. HARENGULA Cuvier and Valenciennes.

Harengula Cuvier and Valenciennes, Hist. Nat. Poiss., XX, 1847, p. 280 (*latula*).

Clupeonia Cuvier and Valenciennes, Hist. Nat. Poiss., XX, 1847, p. 345 (*jussieui*).

Kowala Cuvier and Valenciennes, Hist. Nat. Poiss., XX, 1847, p. 362 (*thoracata* = *kowal*).

Lile Jordan and Evermann, Fish. North and Mid. Amer., I, 1898, p. 431 (*stolifera*).

Small herrings of the tropical seas, with the vertebræ in reduced number, about 40 to 44, and with the scales large, usually firm and adherent, often crossed by vertical striæ; ventral scutes strong, 25 to 35 in number. Skeleton relatively firm. Adipose eyelid obsolete; lower jaw projecting; upper jaw somewhat emarginate; teeth weak. Ventrals inserted behind front of dorsal. Body compressed; cheeks not deep; gill rakers long and numerous. The genus *Harengula*, as here understood, covers considerable diversity of forms.

(Diminutive of *harengus*, a herring.)

KEY TO SPECIES.

a. Eye $2\frac{1}{2}$ in head; scales 40 to 44; depth about 4 in length ..... *zunasi*, 12

aa. Eye $3\frac{1}{2}$ in head; scales 40; depth $3\frac{4}{5}$ ..... *moluccensis*, 13

12. HARENGULA ZUNASI Bleeker.

ZUNASHI: SAPPA.

Clupea kowal SCHLEGEL, Fauna Japon. Poiss., 1846, p. 235, pl. CVII, fig. 1 (Omura, Nagasaki) (not of Rüppell).

Harengula zunasi BLEEKER, Verh. Bat. Gen., XXVI, Japan, 1854, p. 117 (Nagasaki).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Tokyo, Bingo, Chikugo).—JORDAN and STARKS, Proc. U. S. Nat. Mus., XVIII, 1905, p. 193 (Gensan, Korea).

Clupea zunasi GÜNTHER, Cat. Fish., VII, 1868, p. 451 (Nagasaki).—NAMIYE, Class. Cat., 1881, p. 108 (Tokyo).

Sardenella zunasi JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 349 (Tokyo).

Habitat.—Sandy shores of southern Japan, north to Hokkaido.

Head nearly 5 in length; depth a little less than 4 in length; D. 17; A. 19; P. 15; V. 8; scales 40 to 44; eye 2½ in head; snout 4; interorbital space 3½; mandible, a trifle more than 2; pectoral 1¼; V. equal to mandible; caudal peduncle compressed 2⅓.

Body deep, much compressed, the belly sharp; dorsal and ventral profiles both convex, the latter strongly so. Head rather small, compressed, flattened above; snout short, blunt; eye rather large; mouth terminal, almost vertical, the lower jaw projecting; mandible nearly covered by the broad maxillary which extends backward almost as far as center of orbit. Tongue with a median line of very small teeth; lower jaw with a single row of minute teeth which are also sparingly present on posterior part of palatines.

Gill openings large, membranes free from isthmus; gill rakers numerous, fine, slender, longer than gill filaments; pseudobranchiæ present, rather short.

Scales thin, close-set, rather large, more or less deciduous, the margin entire; abdominal scutes present, each prolonged backward into a sharp spine; head naked, preopercle with radiating branching mucous canals beneath eye.

Origin of dorsal to tip of snout a little more than one-third of total length; distance from tip of snout to origin of dorsal equal to distance from posterior end of dorsal base to origin of caudal; anal fin small, its origin distant from base of caudal by a space equal to length of head; caudal deeply emarginate, rather long; pectorals small, about twice eye; ventrals quite small, inserted below middle of dorsal, their length contained 1⅔ times in that of pectoral.

Color, dark lustrous greenish above, sides brassy or silvery, often with an opalescent lustre. Fins yellowish to pale; no dark blotches.

This species is common in the shallow bays of southern Japan, and is often seen in the markets; we have specimens from Tokyo, Onomichi, Tomakomai, in Hokkaido, Wakanoura, Nagasaki, and Tsuruga.

The species strongly resembles *Harengula humeralis* and other scaled sardines of America.

(*zunashi*, the Japanese name.)

13. HARENGULA MOLUCCENSIS Bleeker.

Harengula moluccensis BLEEKER, Nat. Tydschr. Ned., IV, 1853, p. 609 (Molucca).—JORDAN and SEALE, Proc. U. S. Nat. Mus., XXVIII, 1905, p. 770 (Negros).

Clupea moluccensis GÜNTHER, Cat. Fish., VII, p. 427 (Molucca, Ceylon, Ternate).—ISHIKAWA, Prel. Cat., 1897, p. 8 (Miyako, Riu Kiu Islands).

Harengula kunzei BLEEKER, Nat. Tydschr. Ned., XII, p. 209 (Ternate).

Habitat.—East Indies, north to the Riu Kiu Islands.

Head $3\frac{4}{5}$; depth $3\frac{4}{5}$; D. 17 or 18; scales 40–12; head longer than deep; eye $3\frac{1}{2}$ in head. Scales crenulate, deciduous, regularly arranged; cheeks and opercles with fine radiating striæ. Gill rakers 38, fine, closely set. Ventrals inserted below middle of dorsal; 13 scutes behind ventrals. Color, plain, silvery. (Günther).

East Indies, generally common, once recorded from the Riu Kiu Islands. We have specimens from Manila, but none from Japan. (*moluccensis*, living in Molucca.)

12. ILISHA Gray.

Platygaster SWAINSON, Classif. Anim., II, 1839, p. 294 (*africanus*); name preoccupied.

Ilisha (GRAY) RICHARDSON, Ichthyol. China, in Proc. Brit. Assoc., 1846, p. 306 (*abnormis*); no description.

Pellona CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 300 (*orbignyana*= *flavipinnis*).

Ilisha BLEEKER, Ned. Tydskr. Dierk., 1866, p. 300 (*abnormis*).

Body much compressed, the thorax and abdomen strongly serrated. Scales moderate. Lower jaw prominent; mouth moderate, with rasplike bands of minute teeth on jaws, palatines, pterygoids, and tongue; none on vomer. Anal fin very long; ventrals present, small, inserted before the small dorsal; upper ray of pectoral strong; caudal deeply forked. Tropical coasts of America and Asia.

(*ilisha*, apparently a corruption of Iwashi, the Japanese name for sardine.)

14. ILISHA ELONGATA (Bennett).

HIRAKONOSHIRO (BROAD SHAD); HIRA.

Alosa elongata BENNETT, Life of Raffles, 1830, p. 691 (Sumatra).

Pellona elongata GÜNTHER, Cat. Fish., VII, 1868, p. 456 (East Indian and China seas to Japan).—DAY, Fishes of India, 1878, p. 643, pl. CLXIV, fig. 3, and pl. CLXV, fig. 1 (India).

Ilisha elongata BLEEKER, Atlas Ichth., VI, 1892, p. 119, pl. CCLIX, fig. 3 (East Indies).—JORDAN and SEALE, Proc. Davenport Ac. Sci., X, p. 3 (Hongkong).—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 328 (Formosa).

Clupea affinis GRAY and HARDWICKE, Ill. Ind. Zool., I, 1830, pl. XCVI (India).

Pellona affinis CANTOR, Catal. Malay Fish, 1850, p. 291 (Malaysia).

Clupea melastoma SCHLEGEL, Fauna Japonica, Pisces, 1846, p. 237, pl. CVIII, fig. 1 (Nagasaki) (Not of Schneider).

Ilisha abnormis RICHARDSON, Ichthy. China, 1846, p. 306 (Canton).

Pellona grayana CUVIER and VALENCIENNES, Hist. Nat. Poiss., XX, 1847, p. 315 (India), after Gray.

Pellona vimbella CUVIER and VALENCIENNES, Hist. Poiss., XX, 1847, p. 317 (Macao).

Pellona schlegeli BLEEKER, Verh. Bat. Gen., XXVI, 1854, Japan, p. 118 (Nagasaki).

Habitat.—Indian Seas, north to Nagasaki and Wakanoura, scarce in Japan.

Head 4 in length; depth $3\frac{2}{3}$; D. 16; A. 51; scales in lateral line about 56; diameter of eye $3\frac{3}{4}$ in head, equal to snout, and a little more than twice the interorbital space; mandible 2 in head; least depth of caudal peduncle $2\frac{2}{3}$ in head.

Body compressed, elongate but rather deep; abdomen and throat sharp, edged with pointed scutes; abdominal profile more convex than back; head low, compressed in front of eyes, tip of snout blunt, with bulging sides; eye rather large, the cavity about it very large, partially covered with adipose lid; mouth oblique, the upper jaw truncate, with perpendicular sides, the lower jaw very strongly projecting. Upper and lower jaws beset with stout, strongly recurved but very small teeth; bands of minute teeth on tongue, palatines, and pterygoids; none on vomer. Maxillary large, broad, reaching nearly to middle of orbit.

Top of head flattened, with two ridges forming an elongated V; muciferous branching tubules behind eye. Gill openings large, membranes free from isthmus; gill-rakers of first arch strong, rigid, longer than the gill filaments; gill-rakers of other arches much shorter; pseudobranchiæ present.

Scales more or less deciduous, large, cycloid, those on mid line of belly forming strongly serrate scutes; basal portion of caudal scaled; all other fins with basal scaly sheath. An elongated, pointed, fleshy scale in axil of pectoral.

Dorsal small, weak, its insertion midway between tip of snout and base of caudal. Anal low, very long, about $3\frac{1}{2}$ in total length; caudal moderate, deeply forked; pectoral medium $1\frac{2}{3}$ in head; ventrals very small, their length about $\frac{3}{4}$ of diameter of eye.

Color pale yellowish silvery, the dorsal region dusky.

This species here described from a large specimen from Hongkong, China, collected by Capt. William Finch. It is a large herring-like fish abundant in the East Indian and Chinese seas, and occasionally taken on the coasts of southern Japan. We obtained one specimen in Nagasaki, from a Chinaman, who said that it came from the coast of China. Another was seen by us at Wakanoura.

(*elongatus*, elongate.)

Family VII. ENGRAULIDÆ.

Body elongate, more or less compressed, covered with thin cycloid scales. Head compressed. Mouth extremely large, more or less oblique, usually overlapped by a pointed, compressed, pig-like snout. Gape very wide, the maxillary very long and slender, formed of about three pieces, extending backward far behind the eye; in some species beyond the head. Premaxillaries not protractile, very small, firmly joined to the maxillaries. Teeth usually small, in a single row in each jaw; canines sometimes present. Eye large, well forward. Preorbital narrow. Opercles thin and membranceous. Gill-rakers long and slender. Branchiostegals slender, 7 to 14 in number. Gill membranes separate or joined, free from isthmus. Pseudobranchiæ present. No lateral line. Belly rounded or weakly serrate. Fins various; the dorsal usually short and median; no adipose fin; caudal forked. Small, carnivorous fishes, usually swimming in large schools on sandy shores; abundant in all warm seas, occasionally entering rivers.

KEY TO GENERA.

a. Body moderately elongate, the anal fin not confluent with the caudal; no filaments on the pectoral fin; insertion of dorsal in advance of that of anal.
  b. Teeth equally small; gill membranes separate.
    c. Vertebræ about 41; bones firm; tropical species ..... *Anchovia*, 13
    cc. Vertebræ about 45; bones feeble; species of the temperate zone. *Engraulis*, 14
aa. Body greatly elongate, the tail much produced; anal fin very long, confluent with the caudal ..... *Coilia*, 15

13. ANCHOVIA Jordan and Evermann.

Stolephorus BLEEKER, Ned. Tyds. Dierk., III, p. 303 (*"japonicus,"* not of Houttuyn).

Anchovia JORDAN and EVERMANN, Fish. North and Mid. Amer., I, 1898, p. 449 (*macrolepidota*).

This genus, as now understood by us, includes the great multitude of tropical anchovies, characterized by the firm skeleton and by the presence of 40 or 41 vertebræ. Most of the species are compressed, translucent, and with long anal fin, and a silvery band along the sides, which has caused them to be confounded with the true *Stolephorus*. Besides the following species, assigned to Japan by Bleeker, another species, *Anchovia chinensis* Günther, has been wrongly assigned to Japan, on the supposition that it was the original of Houttuyn's *Atherina japonica*. It is recorded by Günther[a] as *Engraulis japonica*.

(*anchovia*, anchovy, an old name of *Engraulis enchrasicolus* of Europe.)

[a] Cat. Fish., VII, p. 390.

15. ANCHOVIA INDICA (Van Hasselt).

Engraulis indicus Van Hasselt, Allgem. Konst. Letterbuch, 1823, p. 329 (East Indies).—Bleeker, Poiss. du Japon., 1879, p. 238.

Stolephorus indicus Bleeker, Atlas Clup., p. 127, pl. cclix (Java, Sumatra, Celebes, Japan).

Anchovia indica Jordan and Evermann, Proc. U. S. Nat. Mus., XXV, 1902, p. 328 (Suwata, Formosa).

Engraulis albus Swainson, Nat. Hist. Fishes, II, p. 293.

Engraulis balinensis Bleeker, Verh. Bat. Gen., XXII, 1839, Bali, p. 11 (Bali).

Engraulis russellii Bleeker, Verh. Bat. Gen., XXIV, Haring, p. 11 (East Indies).—Günther Cat. Fish., VII, p. 390 (Amboyna, Malayan Peninsula).

Habitat.—East Indies.

Head $4\frac{1}{2}$; depth $5\frac{3}{5}$; D. 16; A. 20; P. 13; scales 40.

Snout pointed, much projecting; maxillary saber-shaped, finely toothed, extending to the mandibulary joint; anal inserted below middle of dorsal; abdomen with 4 long slender spines; scales thin, deciduous; a well-defined silvery lateral stripe. (Günther.)

Very abundant in the East Indies; known to us from two specimens from Formosa. Bleeker says that it extends its range northward to Japan, but there is no other record north of Formosa.

(*indicus*, Indian.)

14. ENGRAULIS Cuvier.

Engraulis Cuvier, Règne Animal, 1st. ed., 1817, p. 174 (*encrasicholus*).

Encrasicholus Fleming, British Animals, 1828, p. 183 (*encrasicholus*).

This genus includes spindle-shaped anchovies, little compressed, the sides rounded, the vertebræ about 45 (44 to 47 in species examined), the flesh rather dark, tender, and somewhat oily, not translucent, the bones soft, the appearance and flesh resembling that of the sardines. Temperate zones.

(ἐγγραυλίς, *engraulis*, the ancient name of *Engraulis encrasicholus*, the common anchovy of Europe).

16. ENGRAULIS JAPONICUS Schlegel.

SHIKO, IZASA.

Engraulis japonicus Schlegel, Fauna Japon. Poiss., 1846, p. 239, pl. cviii, fig. 3 (Nagasaki).—Bleeker, Verh. Bat. Gen., XXVI, Japan, 1854, p. 119.—Namiye, Class. Cat., 1881, p. 109 (Tokyo) and of Japanese writers [Reports of Imperial Fisheries Bureau, etc.] generally.—Jordan and Starks, Proc. U. S. Nat. Mus., 1905, p. 194 (Gensan, Korea).

Engraulis ringens Ishikawa, Prel. Cat., 1897, p. 9 (Echigo, Hizen; not of Jenyns).

Habitat.—Coasts of Japan and Korea, in sandy bays.

Head 4 in length, without caudal; $4\frac{3}{5}$ in total length; depth about 7; D. 14; A. 18; P. 17; V. 7; scales in lateral series about 42; eye $3\frac{3}{4}$ to 4 in head; snout 5; mandible $1\frac{1}{2}$; interorbital space about 5; caudal

peduncle moderately compressed, its least depth from 3½ to 3¾ in head.

Body elongate, subcylindrical, somewhat cigar-shaped, thickest in front of middle, head and posterior third of body laterally flattened; snout triangular, the top of head flat, with a small median ridge; lower lower side of head keel-like or wedge-shaped; eyes placed far forward, large, with large adipose lid; mouth inferior, large, the lower jaw comparatively weak, the snout projecting considerably beyond mandible. Mandible armed with a row of minute teeth. Upper jaw with similar teeth in front, these becoming larger behind and extending to posterior end of maxillary. A toothed ridge on middle line of tongue. Gillrakers of first arch slender, numerous, their length equal to that of eye; gill filaments very numerous, fine and slender, their length hardly that of gillrakers of first arch; pseudobranchiæ large, the central ones as long as gill filaments. Scales large, thin, cycloid, deciduous; no abdominal scutes; a long pointed scale in axils of pectorals and ventrals. Dorsal low, but higher than long, the second and third rays longest, their length a little less than 2 in head; the other rays rapidly decreasing, the last contained 3 or 4 times in second; origin of fin midway between tip of snout and base of caudal; anal low, its origin behind posterior end of dorsal about ½ diameter of eye; its length 1⅔ in head; caudal medium, deeply forked; pectorals inserted low, their length 2 in head; ventrals small, inserted less than ½ diameter of eye in front of a perpendicular from origin of dorsal. Color dusky blue above; sides pale brown; in some specimens a broad faint silver band from eye to base of caudal; fins pale, uniform, except caudal, which is more or less dusky. This anchovy is common throughout Japan, constituting an important article of food. We have specimens from Otaru, Hakodate, Same, Aomori, Onomichi, Wakanoura, Misaki, Tokyo, Tsuruga, and Nagasaki.

15. COILIA Gray.

Mystus Lacépède, Poiss., V, 1803, p. 406 (*mystus;* not of Gronow, 1763).
Coilia Gray, Zool. Misc., 1831, p. 9 (*hamiltoni*).
Trichosoma Swainson, Nat. Hist. Fishes, II, 1839, p. 292 (*hamiltoni*).
Chætomus McClelland, Calc. Journ. Nat. Hist., IV, 1843, p. 405 (*playfairi*).
Leptonurus Bleeker, Verh. Bat. Gen., XXII, Madura, about 1849, p. 14 (*chrysostigma*).

Body compressed, terminating in a long tapering tail; head and mouth as in *Engraulis;* scales of moderate size. Anal fin exceedingly long, confluent with caudal; the upper pectoral rays much prolonged, filamentous; belly keeled, with toothed scutes; premaxillary reaching to end of opercle or even to base of pectoral. Air bladder thick-walled, with two thin horns extending forward into the skull. East Indian region.

(Name probably without meaning.)

17. COILIA NASUS Schlegel.

ETSU.

Coilia nasus SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 243, pl. CIX, fig. 4 (Nagasaki).—GÜNTHER, Cat. Fish., VII, 1868, p. 405 (China and Japan).—ABBOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 490 (Tientsin).

Coilia grayi KNER, Novara Fische, 1867, p. 335 (Hongkong; not of Richardson).

Habitat.—Coasts of China and southern Japan.

Head about 7 in length; greatest depth at beginning of dorsal, nearly 7; D. 13; A. 81; P. 6 + 10; scales 62; 11 scales before dorsal; eye 5½ to 6 in head; snout a little more than eye; eye and snout together 1⅓ in head; body elongate, tapering and slender posteriorly; abdomen and throat with 42 conspicuous, sharp, toothed scutes; head pointed, the snout projecting beyond the inferior mouth; premaxillary very long, becoming longer with age, tapering behind, extending to middle of base of pectoral, in young specimens frequently not reaching limit of opercle; jaws, vomer, and palatines with small, sharp-pointed teeth arranged in a single row; tongue covered with velvet-like teeth; gill-rakers fine, closely set, the longest rather longer than the eye. Dorsal rather small, its origin above that of the ventrals; distance from tip of snout to occiput nearly three times in distance to base of dorsal. Anal long and low, its height almost uniform; first six rays of pectoral greatly elongated, the filaments of various lengths, the shortest reaching at least to the beginning of the anal; caudal rather small, irregularly lanceolate or pointed, the upper rays 2½ times as long as the lower.

Coast of China, sometimes extending to Southern Japan; originally described from Nagasaki, but we have seen only Chinese and Korean specimens. On the coast of China is a closely related species, sometimes confounded with *Coilia nasus*. This is *Coilia ectenes* Jordan and Seale. It is more elongate, the anal rays 100 to 113. Scutes 48. Scales 72, 19 before the dorsal. Eye and snout 1¾ in rest of head. It has not been noticed in Japan.

(*nasus*, nose.)

Family VIII. CHIROCENTRIDÆ.

Body elongate, compressed, covered with thin, deciduous scales; abdomen with a sharp but not serrated margin; barbels none. Margin of the upper jaw formed by the premaxillaries mesially, and the maxillaries laterally; cleft of the mouth wide, oblique, the lower jaw projecting. Eye with an adipose lid. Pseudobranchiæ none. Branchiostegals 8. Lateral line obsolete. Dorsal fin short, far back, opposite the long anal. A long, pointed, appendage in axilla. Ventral fins very small. Narrow bands of teeth on palatines, tongue, and pterygoids; a row of canines in mandible and two pairs on premaxillaries.

Stomach with a blind sac; intestines short; pyloric appendages none. With two exceptions *Chirocentrus hypselosoma* Bleeker and *C. dorab*, all the species referred to this family are extinct.

16. CHIROCENTRUS Cuvier.

Chirocentrus Cuvier, Régne Animal, 1817, p. 178 (*dorab*).

Characters of the genus included above:
(χείρ, hand; κέντρον, spine.)

18. CHIROCENTRUS DORAB (Forskål).

Clupea dorab Forskål, Descr. Anim., 1775, p. 72 (Red Sea).
Esox chirocentrus Lacépède, Hist. Nat. Poiss., V, 1803, p. 296.
Chirocentrus dorab Rüppell, N. W. Fische, 1837, p. 81 (Red Sea).—Günther, Cat. Fish., VII, 1868, p. 475.—Bleeker, Atlas Clup., 1870, p. 92 (East Indies).—Day, Fishes of India, I, 1878, p. 652, pl. clxvi, fig. 3 (India).—Jordan and Evermann, Proc. U. S. Nat. Mus., 1902, p. 327 (Formosa).

Habitat.—East Indies, occasionally northward to Japan.

Head about 6 in length; depth about 7; D. 17; A. 33; P. 13; v. 6; eye 4½ in head; snout 3½; mandible 1⅝; interorbital space 5½; caudal peduncle compressed, 2½. Body elongate, compressed; ventral margin sharp; head small, subconical; interorbital space flat with a prominent median ridge anteriorly; snout short; eye covered with adipose lid; a conspicuous fossa before eye; mouth terminal, wide, oblique, the lower jaw strongly projecting; upper lip terminating in a short pointed cutaneous flap; maxillary not large, reaching posteriorly a little beyond anterior margin of eye; mandible longer than maxillary; lower jaw with large canine teeth; two pairs of similar teeth projecting forward from center of premaxillaries; remainder of upper jaw armed with straight, sharp teeth, which soon become much smaller posteriorly; villiform teeth in narrow bands on tongue, palatines, and pterygoid. Gill openings large, membranes free from isthmus; gill rakers short, fine; gill filaments a little longer, fine; pseudobranchiæ none.

Scales small, deciduous, totally absent in our specimen; short cirri along whole extent of abdomen. Radiating, branching mucous canals beneath eye.

Dorsal small, very far back, its origin above that of anal; anal low, long, about 5½ in total length; caudal long, deeply forked; pectorals small, thoracic, the two fins meeting when depressed; basally covered by a long, pointed, cutaneous flap; a large, pointed, dermal, subosseous appendage in the axilla; ventrals very small, their origin midway between tip of mandible and base of caudal.

Color bluish black above, gradually paling on sides to bluish silvery; belly silvery white; fins uniform brownish.

Here described from a single specimen 9½ inches long, obtained by the Imperial University from the Kuro Shiwo near Misaki, the only record of the species from Japan.

This species ranges from the East Coast of Africa to the Malayan Archipelago and north to southern Japan.

(*dorab*, an Arabian name.)

Family IX. ALEPOCEPHALIDÆ.

Body oblong, compressed, covered with thin cycloid or keeled scales or with naked skin; head naked. Lateral line present or absent. No barbels. Mouth moderate or large; margin of the upper jaw formed by the premaxillaries and the maxillaries, the former being placed along the upper anterior edge of the latter. Teeth feeble. Opercular apparatus complete, its bones thin. Phosphorescent spots none, or rudimentary and placed in nodules of the naked skin. No adipose fin; dorsal fin long and low, posterior inserted nearly opposite the anal; pectorals short, placed rather high; ventrals usually well back, sometimes wanting. Gill openings very wide, the membranes free from the isthmus. Pseudobranchiæ present; no gular plate; no air bladder. Stomach curved, without blind sac; pyloric cœca in moderate number.

Fishes of the deep seas; numerous species have been described from the abyssal fauna of the mid Atlantic and Pacific.

17. XENODERMICHTHYS Günther.

Xenodermichthys GÜNTHER, Ann. Mag. Nat. Hist., July, 1878, p. 23 (*nodulosus*).

Body rather elongate, compressed, without true scales; the skin rather tough, finely wrinkled longitudinally, with numerous nodules, regularly arranged; minute, rudimentary, scale-like productions are embedded in the skin, especially on the trunk. Mouth very small, with feeble jaws and rudimentary teeth in the intermaxillary and mandible and a few in the maxillary. Palate toothless. Dorsal and anal fins equal in length. Caudal forked. Gill opening wide, but not much extending above the level of the pectoral fin. Gills well developed, with long gill rakers. Deep seas.

(Ξένος, strange; δέρμα, skin; ἰχθύς, fish.)

19. XENODERMICHTHYS NODULOSUS Günther.

Xenodermichthys nodulosus GÜNTHER, Ann. and Mag. Nat. Hist., July, 1878, p. 23 (south of Yeddo, Japan); Shore Fishes of the *Challenger*, 1880, p. 63 (off Japan).—JORDAN and STARKS, Bull. U. S. Fish Comm., 1902, p. 579 (Sagami Bay, Japan).

Head, 6 in length; depth, 7; D. 32 or 33; A. 31–33; P. 6; V. 5. Eye of moderate size, its diameter greater than width of interorbital space. Lateral line well developed, with scale-like structures; rest of body naked, with fine longitudinal wrinkles.

Color entirely black; luminous nodules all black.

Of this species we have examined one fine specimen, 21.5 cm. long, from station 3697, Sagami Bay, dredged by the United States Bureau

of Fisheries' steamer *Albatross*. It agrees fully with Günther's excellent plate.

(*nodulosus*, having nodules.)

Family X. GONORHYNCHIDÆ.

Head and body entirely covered with ctenoid scales; a barbel present under the elongate, pointed snout; margin of upper jaw formed by the short premaxilliary, which is continued downward as a thick lip, in front of the maxillary. Jaws toothless; lips thickly fringed with barbels.

Dorsal fin far back, opposite ventrals, short, like the anal.

Pseudobranchiæ present; gill openings narrow. Air bladder absent.

Branchiostegals four.

A single genus with two or three species known among living fishes. Several extinct genera are placed near *Gonorhynchus*. It differs strongly from all other herring-like fishes in having the head closely scaled.

18. GONORHYNCHUS Gronow.

Gonorhynchus GRONOW, Zoophylaceum, 1763, (No. 199=*G. gonorhynchus*).

Rhynchana RICHARDSON, Voy. Erebus and Terror, 1846, p. 44 (*greyi=gonorhynchus*).

The characters of this genus are included above. The single Japanese species differs from *Gonorhynchus gonorhynchus* of the Cape of Good Hope and neighboring waters in the deeper body, longer head, and a smaller number of fin rays. *Gonorhynchus gonorhynchus* is said to have the head about $5\frac{2}{3}$ in length, the dorsal 11 to 13, and the anal rays 9. *Gonorhynchus brevis* Kner, slender and short-headed, is probably the same.

20. GONORHYNCHUS ABBREVIATUS Schlegel.

Gonorhynchus abbreviatus SCHLEGEL, Fauna Japon. Poiss., 1846, p. 217, pl. CIII, fig. 5 (Nagasaki).—JORDAN and SNYDER, Smiths. Misc. Coll., XLV, 1904, p. 236, pl. LIX (Yokohama).

Habitat.—Southern Japan in deep water, very rare.

Head $4\frac{2}{5}$ in length of body to base of caudal, $4\frac{5}{6}$ times in total length; the depth is a little more than half the length of the head, about 9 in total length; D. 11; A. 8; P. 1+10; V. 1+7; eye $4\frac{1}{2}$ in head; snout, $2\frac{1}{2}$; interorbital space, about 4; caudal peduncle, $4\frac{1}{4}$.

Body elongate, subcylindrical, caudal portion tapering; head medium, conical, the snout long and pointed, a single medium barbel behind its tip; nostrils double, the upper or anterior one with a short fleshy tube which partially covers the lower nostril. Mouth inferior, nearly simicircular, with thick, fringed or fibrillose, toothless jaws.

Eye large, covered with an adipose lid.

Gill membranes attached to isthmus; pseudobranchiæ present; "a fringed gill-like organ behind the fourth branchial arch, one-half being attached to this arch, the other half to the humeral arch."

Scales small, ctenoid, entirely covering the head and body, scales in lateral line, about 180.

Dorsal small, very far back, its origin opposite posterior insertion of ventrals; anal small, short, its origin a short distance behind anus, and a little more than half the distance between insertion of ventral and base of caudal; pectoral long, 1¼ in head; a long, pointed, fleshy, scaly flap in axilla of pectorals, ventrals, dorsal and anal; caudal small, moderately forked, the basal half scaled.

FIG. 5.—GONORHYNCHUS ABBREVIATU

Color uniform brown, paler beneath, fins pale basally, the distal half black; pectoral edged with white.

This description is taken from a fine specimen from off Yokohama, obtained by Mr. Alan Owston. No other specimen has been seen since the time of Schlegel.

(*abbreviatus*, shortened.)

SUMMARY.

Family ELOPIDÆ.

1. *Megalops* Lacépède, 1803.

1. *cyprinoides* (Broussonet), 1782; Okinawa.

2. *Elops* Linnæus, 1766.

2. *saurus* Linnæus, 1766.

Family PTEROTHRISSIDÆ.

3. *Pterothrissus* Hilgendorf, 1877.

3. *gissu* Hilgendorf, 1877; Hakodate, Suruga Bay, Matsushima Bay, Tsugaru Straits.

Family ALBULIDÆ.

4. *Albula* Gronow, 1763.

4. *vulpes* (Linnæus), 1758; Tokyo.

Family CHANIDÆ.

5. *Chanos* Lacépède, 1803.

5. *chanos* (Forskål), 1775.

Family DOROSOMATIDÆ.

6. *Konosirus* Jordan and Snyder, 1900.

6. *punctatus* (Schlegel), 1846; Tokyo, Nagasaki.
7. *nasus* (Bloch), 1797; Urado.

Family CLUPEIDÆ.

7. *Etrumeus* Bleeker, 1853.

8. *micropus* (Schlegel), 1846; Aomori, Same, Tokyo, Wakanoura, Misaki, Nagasaki.

8. *Stolephorus* Lacépède, 1803.

9. *japonicus* (Houttuyn), 1782; Wakanoura, Nagasaki, Osaka, Heda.

9. *Clupea* Linnæus, 1758.

10. *pallasii* Cuvier and Valenciennes, 1847; Otaru, Kushiro, Aomori, Matsushima Hakodate, Same.

10. *Sardinella* Cuvier and Valenciennes, 1847.

11. *melanosticta* (Schlegel), 1846; Hakodate, Matsushima, Aomori, Same, Yokohama, Tokyo, Tateyama, Onomichi, Wakanoura, Kobe, Tsuruga, Nagasaki.

11. *Harengula* Cuvier and Valenciennes, 1847.

12. *zunasi* Bleeker, 1854; Tokyo, Onomichi, Tomakomai, Wakanoura, Tsuruga, Nagasaki.
13. *moluccensis* Bleeker, about 1853.

12. *Ilisha* Gray, 1846.

14. *elongata* (Bennett), 1830; Wakanoura.

Family ENGRAULIDÆ.

13. *Anchovia* Jordan and Evermann, 1898.

15. *indica* (Van Hasselt), 1823.

14. *Engraulis* Cuvier, 1817.

16. *japonicus* Schlegel, 1846; Hakodate, Aomori, Otaru, Same, Onomichi, Tokyo, Misaki, Tsuruga, Nagasaki.

15. *Coilia* Gray, 1831.

17. *nasus* Schlegel, 1846; Nagasaki.

Family CHIROCENTRIDÆ.

16. *Chirocentrus* Cuvier, 1817.

18. *dorab* (Forskål), 1775; Misaki.

Family ALEPOCEPHALIDÆ.

17. *Xenodermichthys* Günther, 1878.

19. *nodulosus* Günther, 1878; Sagami Bay.

Family GONORHYNCHIDÆ.

18. *Gonorhynchus* Gronow, 1763.

20. *abbreviatus* Schlegel, 1846; Yokohama.